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12 October 2012 **Sent via e-mail**

Environmental Monitoring Advisory Board (EMAB)
506 Franklin Avenue, 2nd Floor
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Attention: Michelle Letourneau, Communications Coordinator

Re: Peer Review of the Proposed Air Quality Monitoring Program for the Diavik Diamonds Mine Inc. (DDMI)

Dear Ms. Letourneau:

I have reviewed the proposed Air Quality Monitoring Program for DDMI as presented in a memorandum dated September 26, 2012 from Mark Milner et al. of Golder Associates to David Wells, Superintendent, Environment for Rio Tinto. According to this document, the proposed monitoring program would consist of SHARP 5014i continuous beta attenuation monitors for the measurement of TSP and $PM_{2.5}$ at one location, high volume samplers for TSP monitoring at two additional locations on a one-in-six day schedule, and monthly passive sampling of NO_2 at all three monitoring locations, in addition to the existing dustfall sampling program.

The concerns that were noted in a peer review that I completed in 2006 for the dustfall monitoring program do not appear to have been addressed. The memorandum from Golder issued in September 2012 indicates that fine particulate matter concentrations may exceed the ambient air quality standard of 30 $\mu g/m^3$ as defined by the Government of the Northwest Territory (NWT), although the basis of this conclusion is not provided by Golder other than in the form of a figure showing that the standard may be exceeded up to 5 times per year. The $PM_{2.5}$ analysis seems to be based on a new dispersion modelling analysis which has not been provided for this review. No information has been provided as to the potential magnitude or frequency of the predicted exceedances for TSP or NO_2 in respect to the proposed monitoring program in 2012, and the information provided on the potential frequency of exceeding the $PM_{2.5}$

criterion is sketchy at best. Therefore, it is impossible to judge the degree of concern that may exist with respect to any exceedances of the ambient air quality criteria.

Summary of Findings

This peer review is based only on the above mentioned memorandum. No other reports or documents were made available to the reviewer. No electronic files such as emission calculation spreadsheets, meteorological files and CALPUFF modelling files were made available to the reviewer.

The primary concerns with the proposed monitoring program are as follows:

- rationale for the location of the monitoring site based on the dispersion modelling results;
- rationale for the use of passive NO_2 monitoring instead of using standard continuous sampling methods;
- lack of any explanation for how the proposed 1-in-6 day TSP sampling program would be related to the existing dustfall sampling program;
- lack of any information about the dustfall sampling program in light of previous criticisms on the use of non-standard dustfall sampling methods;
- lack of clarity on which regulatory criteria will be used to assess compliance.

The basis for these concerns is discussed in more detail below. My recommendations are that, before the monitoring program is established, Golder provide:

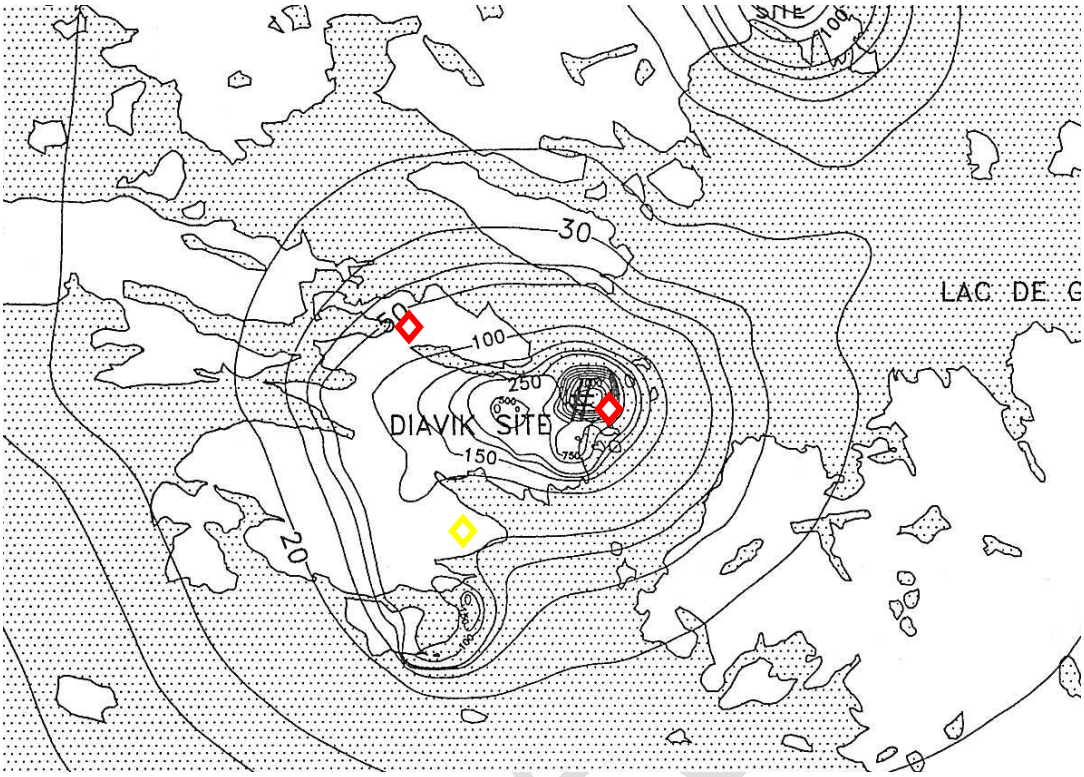
1) additional justification for the location of the proposed air quality monitoring station in the form of more detailed maps showing maximum predicted concentrations of TSP, $PM_{2.5}$ and NO_2 sampling;
2) justification for why continuous NO_2 sampling cannot be provided instead of the proposed passive NO_2;
3) rationale for how the existing dustfall collection program will be integrated with the results of the proposed TSP sampling program;
4) if non-standard dustfall sampling is still being used, evidence that the non-standard sampling program produces comparable results to standard dustfall sampling methods;
5) clear definition of which regulatory criteria will be used to evaluate the results of the air quality monitoring program.

Monitoring Site Locations

The proposed air quality monitoring plan for the Diavik mine is deficient in providing detailed justification for the location of the proposed continuous TSP and $PM_{2.5}$ monitoring station, as well as the two proposed Hi-Vol TSP and three NO_2 sampling locations. Figure 1 in the Golder memorandum provides a single isopleth line showing that the frequency by which the 24-hour average $PM_{2.5}$ concentration could exceed 30 $\mu g/m^3$ is about 5 times per year. Since all three monitoring sites are located on the edge of the area circumscribed by the isopleths, it may be assumed that higher frequencies of occurrence for such exceedances might be expected somewhere within this area, but Golder has not provided any information to determine how close or how far away such areas may be to the locations of the proposed monitoring sites. Furthermore, the isopleths showing potential exceedances of the $PM_{2.5}$ criterion tells the reviewer absolutely nothing about the location of maximum predicted TSP concentrations relative to the location of the continuous sampling site and the two sequential sampling sites. Therefore, it is impossible to tell whether the location of the proposed particulate sampling sites is appropriate to the purpose of determining compliance with any regulatory criteria for ambient air particulate matter concentrations.

In a previous review of the proposed air quality monitoring program for the Diavik mine completed in 2006, I noted that the measured dustfall deposition rates in 2004 at a number of sampling locations were at least ten times higher than was predicted in the Environmental Effects Report dispersion modelling analysis in 1998. The maximum dustfall deposition rate was estimated in the 1998 analysis to be >750 mg/dm^2 per year in the area nearest the mine pit which may have been an underestimate given that the measured dustfall rates in the period 2002-2004 exceeded expected rates by over an order of magnitude. If a new dispersion modelling analysis has been performed since 2006, this information should be provided in support of any new air quality monitoring program.

Judging by the 1998 dispersion modelling analysis (Figure 6-9 of the Environmental Effects Report), two of the three proposed TSP monitoring sites lie on the outer edges of the dustfall footprint as indicated below reproduced from the 1998 report. Only the Hi-Vol TSP monitoring site nearest the mine pit falls close to the predicted area of highest dustfall. The other two sites, including the continuous TSP and $PM_{2.5}$ monitoring site (yellow diamond), are situated in areas of relatively low dust concentrations. If Golder has a new analysis that better justifies the location of the three particulate monitoring sites than is available from the 1998 analysis, then that information is relevant to understanding how the sites were selected and should be disclosed as further justification for the selection of these three sites for the air quality monitoring program.



In addition, since haul roads are the major sources of TSP emission in mining operations, it would have been helpful if Figure 1 in the Golder memorandum showed the location of these haul roads in relation to the proposed TSP and $PM_{2.5}$ sampling sites.

Similarly, absolutely no information was provided on the predicted concentrations of NO_2 to justify locating the passive NO_2 sampling sites at these three locations. The locations chosen appear to have more to do with convenience in locating the samplers close to the particulate sampling sites rather than to any consideration of the predicted concentration of NO_2 levels due to Diavik mine operations.

In summary, the information provided by Golder to justify the locations of the three air quality monitoring sites is inadequate to determine whether the sites are located close to where they are likely to determine the maximum concentrations of TSP, $PM_{2.5}$ or NO_2 due to mine operations. The locations of the three monitoring sites appear to have more to do with the availability of power to run the particulate sampling equipment than to their appropriateness for determining compliance with regulatory criteria.

NO_2 Sampling Program

Setting aside the concerns raised above as to whether or not the proposed monitoring locations are appropriate with respect to maximum predicted NO_2 concentrations, additional justification should be provided as to why the proposed NO_2 monitoring program will be limited to passive NO_2 sampling on a monthly basis. The Golder memorandum states that:

> "Passive monitoring of NO_2 compounds will be conducted to demonstrate compliance with the NWT standards (GNWT 2011) and National Ambient Air Quality Objectives (NAAQO) (Environment Canada 2010)."
>
> and
>
> "The ambient NO_2 concentrations measured at the passive monitoring station will be analyzed for indications of air quality concerns (e.g., increasing trends or measured concentrations above the ambient air standards). The analysis of NO_2 sampling results will include the comparison of results with the NWT standards (GNWT 2011) and NAAQO (Environment Canada 2010). However, since the passive sampling will be on a monthly basis and the NWT standards do not have monthly criteria for NO_2, the annual average of the monthly data will be compared to the annual NWT standard of 60 µg/m3 for NO_2."

In over 35 years of air quality work conducted across Canada, I have never come across a situation where the annual average NO_2 concentration exceeded the annual Maximum Desirable NAAQO level, even in the most heavily industrialized portions of the country. Therefore, in my professional opinion, it was unlikely that the proposed passive NO_2 sampling program at Diavik would show any such exceedance. Demonstrating that there would be no such exceedance of based on monthly averaged concentrations through the proposed passive sampling program is a waste of time and effort because compliance with the annual NWT standard will provide absolutely no information about whether or not the 1-hour average and 24-hour average NWT standards were likely to be exceeded. It is the 1-hour and 24-hour average concentrations that are of interest, not the monthly or annual averages. Only continuous sampling using regulatory standard methods will provide that information. If there is power available at the proposed monitoring sites to run TSP and $PM_{2.5}$ samplers, then there is power available to also run continuous NO_2 samplers. The use of passive monthly NO_2 sampling is inappropriate and should not even be considered.

Integration of TSP and Dustfall Sampling Programs

In the previous review of the dustfall sampling program conducted at the Diavik Mine which I completed in 2006, I had expressed my concern that the sampling methodology for the dust gauge sampling network used by DDMI was inconsistent with recommended practice, and that the failure by DDMI to follow the recommended standard practice may have compromised the accuracy of the sampling results. At that time, I had recommended that, at the very least, the Diavik sampling methods be tested with side-by-side standard dustfall sampling methods in order to demonstrate that the results of Diavik's methods produce comparable results with those derived using standard sampling methods. I testified to these concerns during the Wek'èezhìi Land and Water Board public hearings on Diavik Diamond Mines' Application to renew Water Licence N7L2-1645 (re-numbered to MV2005L2-0009) in 2006.

If DDMI is now using standard dustfall collection methods, then these concerns would have been addressed. If, on the other hand, DDMI is still using non-standard methods for dustfall collection, then DDMI should provide evidence to support their case that the non-standard sampling methods produce equivalent results to those of standard sampling methods.
In addition, however, the Golder memorandum states that:

> "This proposed (particulate matter) monitoring is in addition to the current, extensive dustfall collection system and reporting process at the mine."

The implication is that the two monitoring programs are somehow complimentary. However, I am unaware of any studies showing that there is a direct correlation between 24-hour average TSP sampling collected using high volume samplers, and dustfall sampling collected on a 30 day average. In over 35 years of work in air quality, including air quality monitoring programs for mining operations, I have never come across evidence of a direct relationship between the two (i.e., dustfall levels and ambient TSP levels). If Golder has any evidence for such a relationship, it would be useful for all concerned to be provided with that information.

Regulatory Criteria

In an earlier version of the proposed air quality monitoring plan dated June 25, 2012, Golder had included a table of regulatory criteria that would be used to evaluate the results of the monitoring program. Table 1 in the June 25th Golder memorandum listed the ambient air quality criteria adopted by the Government of the Northwest Territories and the Federal Government. The parts of Table 1 relevant to the revised monitoring plan for TSP, $PM_{2.5}$ and NO_2 are reproduced below,

updated with the NWT standards that were adopted in 2011.

Table 1: Relevant Ambient Air Quality Criteria

Parameter	NWT Standard ($\mu g/m^3$)	Canada-Wide Standard ($\mu g/m^3$)	National Ambient Air Quality Objectives ($\mu g/m^3$)		
			Maximum Desirable	Maximum Acceptable	Maximum Tolerable
NO_2					
1-hour	400	---	---	400	1,000
24-hour	200	---	---	200	300
Annual	60	---	60	100	---
TSP					
24-hour	120	---	---	120	400
Annual	60[a]	---	60[b]	70	---
$PM_{2.5}$					
24-hour	30	30[c]	---	---	---
Annual	---	---	---	---	---

Notes:
[a] arithmetic mean
[b] geometric mean
[c] 98th percentile average over 3 consecutive years

Note that there is no further need for Golder to use the NAAQO for evaluating the results of the air quality monitoring program because the NWT standards address all three air contaminants included in the program. However, as noted in the comments on the proposed NO_2 sampling program, the use of passive NO_2 monitoring will not address the need for demonstrating compliance with the NWT standards for 1-hour and 24-hour average concentrations.

The Golder memorandum also fails to make note of the fact that the Federal Government is set to announce a new framework for ambient air quality management in Canada later this year. This new approach to air quality management will be based on the framework that was developed in 2010 for the Comprehensive Air Management System (CAMS)[1]. The new framework is expected to include some new Canadian Ambient Air Quality Standards (CAAQS), but the most important feature of the new framework will be the requirement to reduce emissions even in regions of the country that meet the standards. The Northwest Territories would be included in the Northern air management zone of the new framework, and as such would be subject to its provisions. The analysis and interpretation of the monitoring data should include a comparison with the new framework when it is announced. Specifically, the new approach to air quality

[1] Comprehensive Air Management System (CAMS) Steering Committee 2010. A Proposed Framework to Improve Air Quality Management.

management is expected to adopt the system of air quality levels and action triggers outlined for CAMS as listed below in Table 2. Table 3 lists some proposed management options that would correspond to the air quality levels.

Table 2: Proposed CAMS Air Quality levels and Action Triggers

Level	Description of air quality	Proposed trigger
Green	**Low pressure on air quality.** Good air quality in relatively undeveloped or pristine areas.	
Yellow	**Under pressure.** Air quality somewhat degraded as a result of industrial development, transportation, or residential, transboundary or other factors.	Background level of pollutants plus a buffer to allow for some growth or development.
Red	**CAAQS encroachment.** Air quality significantly degraded; ambient pollution levels approaching CAAQS.	Two-thirds of range between yellow trigger and CAAQS. Range should allow room for actions to prevent exceedance of CAAQS
Black	**Non-attainment.** Ambient air pollution in air zone is above CAAQS level (as determined by levels at one or a cluster of monitoring stations in the same local area.	CAAQS

Table 3: Proposed Air Quality Levels and Air Zone Management Recommendations

Level	Air Zone Management Recommendations
Low pressure on air quality	• Basic air quality surveillance, potentially via remote sensing or modelling in northern or inaccessible areas • Periodic reporting to the public on the state of air quality, and public education • If development pressures arise, planning and actions based on principles of Keeping Clean Areas Clean and Continuous Improvement
Under pressure	• Active air quality management • Development of action plan to reduce air quality deterioration, including actions to be undertaken on relevant sources and to estimate impacts on air quality • Air quality monitoring that is sufficient to assess/identify relevant air quality issues • Inventory and mapping of major emission sources; modelling of emission patterns, where required • Involvement of various levels of government as needed • Stakeholder involvement in air management efforts, potentially through establishment of multi-stakeholder air zone management team • Public education and engagement • Development of sustainable economic and urban development policies that ensure air quality does not degrade
CAAQS encroachment	• Development and implementation of rigorous action plan that: o Identifies the key sources contributing to the exceedance of the CAAQS o Sets out the full range of actions to be undertaken by appropriate governments and relevant stakeholders to reduce the pollutants of concern in the air zone o Provides milestones and timelines to meet targets o Provides greater accountability through periodic progress assessments o Uses mapping and modelling to demonstrate how actions will result in improved air quality
Non-attainment	• Implement rigorous actions to reduce emissions. • Development and implementation of an action plan that: o includes short-term to long-term actions (regulatory action wherever required) to achieve air quality improvements in order to bring air quality below the CAAQS; o establishes milestones and timelines for actions by each level of government and relevant stakeholder; o provides for regular progress assessment and public reporting to ensure transparency and accountability; o uses detailed modelling to show how planned actions will result in improved air quality. • Stronger provincial and federal involvement in air quality management, including: o direct role by province or territory in coordinating and approving planning and actions; o collaboration between governments, with each utilizing authority to reduce emissions in areas of jurisdiction.

I trust that the information provided in this letter meets with your requirements. Please call me if you require any additional information or clarifications of the information contained in this letter.

Yours very truly,

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